CLAIMS:

1. An information storage system comprising an optical record carrier having at least two information planes, and a reading device for scanning the information planes from one side of the record carrier, said device comprising a first optical system for forming a radiation spot on an information plane to be read, a second optical system for passing radiation from the record carrier to a radiation-sensitive detection system which converts the radiation into an electric detection signal, and a detection circuit electrically connected to the detection system for converting the detection signal into an information signal, characterized in that the distances between the information planes and the optical properties of the information planes comply with the interference requirement of the information storage system, *i.e.* the ratio between the sum of interference signals in the detection signal generated by the information planes not to be read and a read signal in the detection signal generated by the information plane to be read is smaller than an interference ratio Q determined by the detection circuit.

2. An information storage system as claimed in Claim 1, characterized in that the interference requirement is defined by

$$\frac{\sum_{j \neq i} E_j \sum_f m_j(f)\ MTF(f, d_j/n)}{E_i \sum_f m_i(f)\ MTF(f,0)} < Q ,$$

in which the summation over j is over all information planes not being the information plane i to be read, and the summation over f is over the frequencies present in the signal received from an information plane, while E_j is the power of the radiation in the zeroth diffraction order from information plane j, $m_j(f)$ is the modulation factor at frequency f of the information plane j, in which $m_j(f)$ for an information plane not to be read is determined with the radiation beam focused on plane j, and in which further $MTF(f,d_j/n)$ is the modulation transfer function at the frequency f of the radiation from the information plane j to the detection signal, d_j is the distance between the information plane j and the information plane i to be read, and n is the refractive index of the

medium between the information planes i and j.

3. An information storage system as claimed in Claim 1, characterized in that the interference requirement is defined by

$$\frac{\left(\sum_{j\neq i}\left(\sum_{f} E_j\, m_j(f)\, MTF(f,d_j/n)\right)^2\right)^{\frac{1}{2}}}{\sum_{f} E_i\, m_i(f)\, MTF(f,0)} < Q\,,$$

in which the parameters have the meaning as defined in Claim 2.

4. An information storage system as claimed in Claim 1, characterized in that the record carrier has at least three information planes and in that the sum in said interference requirement includes imaginary information planes each constituted by mirroring an information plane with respect to another information plane.

5. An information storage system as claimed in Claim 2 or 3, characterized in that a first information plane has an information structure which is optimally read in a first read mode, and at least a second information plane has an information structure which is optimally read in a second read mode, in that the reading device has the disposal of both read modi and in that in the interference requirement the parameters E_j, m_j and $MTF(f,d_j/n)$ for an information plane which is not to be read have those-values which are associated with the read mode in which the information plane i to be read is read.

6. An information storage system as claimed in Claim 5, characterized in that the radiation source is adapted to supply a radiation beam having a first wavelength in the first read mode and a radiation beam having a second wavelength in the second read mode.

7. A reading device as claimed in Claim 5 or 6, characterized in that the detection system has the disposal of two detection modi for detecting, in the first and the second read mode, the radiation from the record carrier in the first and the second detection mode, respectively.

8. An information storage system as claimed in Claim 2 or 3, characterized in that the record carrier has at least three information planes, in that the detection system is arranged in the path of radiation reflected by the record carrier, and in that

$$\frac{E_j}{E_i} = \frac{R_j}{T_j^2\, R_i}$$

for an information plane j which is situated closer to the objective system than the information plane i, and

$$\frac{E_j}{E_i} = \frac{T_i^2 R_j}{R_i}$$

for an information plane j which is situated further remote from the objective system than the information plane i, in which R_k and T_k are the radiation intensity reflection and the radiation intensity transmission, respectively, of information plane k.

9. An information storage system as claimed in Claim 4, characterized in that the optical properties of the information planes comply with

$$\frac{R_2 \sum_f m_1(f)\, MTF(f, d_2/n) + R_2^2 R_1 \sum_f m_1(f)\, MTF(f, (d_1-d_2)/n)}{T_2^2 R_3 \sum_f m_3(f)\, MTF(f, 0)} < Q$$

in which d_1 and d_2 are the distances between the information planes 1 and 2, and 2 and 3, respectively, and n is the refractive index of the media between the information planes.

10. An information storage system as claimed in Claim 9, characterized in that the information planes comprise information having a substantially equal frequency spectrum, in that m_1, m_2 and m_3 are equal to each other, d_1 is equal to d_2, and in that

$$\frac{R_2^2 R_1}{T_2^2 R_3} < Q$$

holds for the radiation intensity reflections and radiation intensity transmissions of the information planes.

11. An information storage system as claimed in Claim 8, characterized in that the radiation intensity reflection coefficients of the successive information planes with an increasing distance of the objective system comply with

$$R_{j+1} = \frac{R_j}{T_j^2}.$$

12. An information storage system as claimed in any one of Claims 2 to 11, characterized in that the information in the information planes is ordered in tracks

extending in a tangential direction, denoted by the subscript t, and in that the modulation transfer function *MTF(f,d)* is given by

$$MTF(f,d) = MTF_t(f,d)\ F_r(q,d)$$

in which, expressed in the dimensionless parameters

$$\omega = \frac{f}{f_c} \qquad \xi = \frac{2dNA^2}{\lambda}$$

$$\eta = \frac{r_d}{2M\,NA\,d} \qquad \kappa = \frac{q\,NA}{\lambda},$$

the tangential modulation transfer function is given by

$$MTF_t(\omega,\xi) = \frac{2}{\pi}\iint_S d\beta\ d\epsilon\ \cos(\pi\xi\beta\omega)$$

with S being the area defined by

$$0 < |\beta| < 1-\frac{\omega}{2},\quad 0 < \epsilon < \sqrt{1-\left(|\beta|+\frac{\omega}{2}\right)^2} \qquad \text{if } \eta > \sqrt{1-\left(\frac{\omega}{2}\right)^2},$$

$$0 < |\beta| < \eta,\qquad 0 < \epsilon < \sqrt{\eta^2-\beta^2} \qquad \text{if } \eta < 1-\frac{\omega}{2} \text{ and}$$

the area of overlap of said two areas $\qquad$ if $1-\frac{\omega}{2} \le \eta \le \sqrt{1-\left(\frac{\omega}{2}\right)^2}$,

and in which the radial function is given by

$$F_r(\kappa,\xi) = \mathrm{sinc}\left(\frac{\xi^2}{1,8}\right) \qquad \text{if } \xi < 2,1 \quad \text{and}$$

$$= \frac{\left(1+\frac{\sqrt{\pi}\,\xi}{2\kappa}\right)^{\frac{1}{2}}}{4\xi} \qquad \text{if } \xi \ge 2,1,$$

in which $f_c = NA/\lambda$ is the cut-off frequency of the objective system, λ is the wavelength of the radiation beam, NA is the numerical aperture of the objective system at the side of the record carrier, q is the track period, r_d is the effective radius of the

detection system, and M is the magnification of the optical system from the record carrier to the detection system.

13. An information storage system as claimed in Claim 2 or 3, characterized in that the radiation received by the detection system is transmitted by the record carrier, and in that

$$E_j \neq E_i .$$

14. An information storage system as claimed in Claim 2, 3 or 13, characterized in that the optical system comprises a collector lens for passing radiation transmitted by the record carrier to the detection system, in which the numerical aperture of the collector lens is equal to the numerical aperture of the objective system, and in that the information in the information planes is ordered in tracks extending in a tangential direction, denoted by the subscript t, and in that the modulation transfer function *MTF(f,d)* is given by

$$MTF'(f,d) = MTF'_t(f,d)\ F_r(q,d)$$

in which, expressed in the dimensionless parameters, the tangential modulation transfer function is given by

$$MTF'_t(\omega,\xi) = \frac{2}{\pi}\left[\arccos\left(\frac{\omega}{2}\right) - \frac{\omega}{2}\sqrt{1-\left(\frac{\omega}{2}\right)^2}\right] *$$

$$\frac{1}{\pi}\int\!\!\int_S d\beta\, d\epsilon\ \cos(\beta\omega + \pi\xi\omega^2)\ \frac{J_1\left(\sqrt{\beta^2+\epsilon^2}\right) J_1\left(\sqrt{(\beta+\pi\xi\omega)^2+\epsilon^2}\right)}{\sqrt{\beta^2+\epsilon^2}\ \sqrt{(\beta+\pi\xi\omega)^2+\epsilon^2}}$$

with S being the area defined by

$$-\sqrt{\zeta^2-\epsilon^2} < \beta < \sqrt{\zeta^2-\epsilon^2} \quad \text{and} \quad -\zeta < \epsilon < \zeta,$$

$$\zeta = \frac{2\pi\, NA\, r_d}{M\lambda}$$

and in which the other parameters have the meaning as defined in Claim 12.

15. An optical carrier having at least two information planes and comprising all the technical record carrier features as defined in any one of Claims 1 to 14.

16. An optical carrier as claimed in Claim 15, characterized in that it comprises three information planes and two intermediate layers separating the information planes from one another, the ratio of the optical thicknesses of the intermediate layers ranging between 1,5 and 3.

17. An optical record carrier as claimed in Claim 15, characterized in that it comprises information planes with interposed intermediate layers, the successive intermediate layers having thicknesses alternating with each other in two different values.

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